Occupational Health and Safety Scorecards : New leading indicators improve risk management and regulatory compliance

Frédéric Juglaret, Jean-Marc Rallo, Raoul Textoris, Franck Guarnieri, Emmanuel Garbolino

OCCUPATIONAL HEALTH AND SAFETY SCORECARDS: NEW LEADING INDICATORS IMPROVE RISK MANAGEMENT AND REGULATORY COMPLIANCE

Frédéric Juglaret
Preventeo and Mines ParisTech,
6, Rue de l'abreuvage
06110 Le Cannet, France

Jean-Marc Rallo
Preventeo,
6, Rue de l'abreuvage
06110 Le Cannet, France

Raoul Textoris
L'Oréal,
1 Avenue Eugène Schueller
93600 Aulnay sous bois, France

Franck Guarnieri, Emmanuel Garbolino
Center for Research on Risk and Crisis, Mines ParisTech,
1, Rue Claude Daunesse
06904 Sophia-Antipolis Cedex, France

Abstract

While it has been established for many years that the management of Occupational Health and Safety (OHS) is carried out by means of Management Systems, the question of how to measure the performance and the control of these systems is still current. The first part of the article addresses the issue of the traditional indicators identified in the literature. Once defined, their contribution and limitations are discussed. Next, the general concept of Balanced Scorecards is described, along with a survey of the work that has been carried out in the OHS domain. Finally, an example from the aeronautic and aerospace industry is used to illustrate the Balanced Scorecards model. It integrates leading management indicators for two particularly interesting sub-processes of a Management System; namely, the supervision of regulatory compliance and risk management.

Keywords: Occupational health and safety management system, balanced scorecard, leading and lagging indicator, cccupational risks and regulatory compliance management.

1. Introduction

Occupational Health and Safety (OHS) management plays a prominent role in most companies. While it has been established for many years that the management of OHS is carried out by means of Management Systems, the question of control and measurement of the performance of these systems is still current. Traditionally based on performance indicators, the method and results have several constraints and limitations. This article addresses this problem, and discusses the opportunities and benefits of the use of advanced indicators integrated into a Balanced Scorecard. This article consists of four parts. The first deals with the issue of traditional safety indicators. Once defined, their contribution and their limitations are discussed. The general concept of the scorecard is then presented together with a survey of existing work in the OHS domain. A model of the OHS Balanced Scorecard which integrates management indicators at various levels of a management system is then proposed. Finally, an OHS Balanced Scorecard is applied to a company in the aerospace sector. This integrates advanced management indicators into two particularly interesting sub-processes of a management system, namely: management of regulatory compliance and risk management.y

2. Classic OHS indicators

2.1 Method of construction of traditional indicators

Companies have traditionally used safety results as indicators to measure safety performance. For the most part these results involve counting the number of working days last through temporary incapacity, due either to work-related accidents or illness. Undesirable events are therefore measured in terms of frequency and severity rates. Following are two examples of how these frequency and severity rates can be calculated:

$$Frequency\ Rate = \left(\frac{number\ of\ work\ related\ accidents}{number\ of\ hours\ worked}\right) * 1\,000\,000$$

$$Severity\ Rate = \left(\frac{number\ of\ days\ lost\ through temporary incapacity}{number\ of\ hours\ worked}\right) * 1\,000\,000$$

To illustrate this point, Figure 1 shows the evolution in the frequency and severity rates of accidents respectively recorded for a French public sector construction company. The accident and illness rates are compared numerically to those of prior periods at the same organizational level of the company. In this example, the frequency and severity rates of accidents were respectively quartered and more than halved in the period 2002 - 2009. The use of frequency and severity rates (assuming the same method has been used to construct the metric) also allows a comparison to be made between different branches or parts of the industrial network (benchmarking).

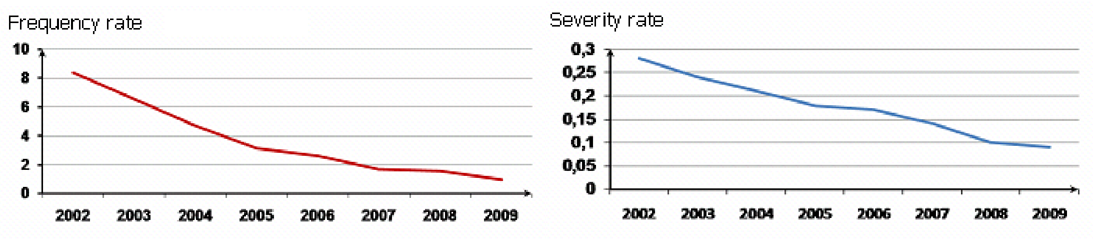

Figure 1: Evolution of the frequency and severity of accidents and illness

Another advantage is that it makes it relatively easy to translate OHS results into financial terms. A business can easily calculate the costs of failure or deficiencies due to OHS policy. These procedures enable a final check to be made of whether the organization’s long-term OHS strategy (and all its constituent policy elements), have been enough to achieve its objectives.

2.2 Limits of traditional OHS indicators

While the use of these retrospective results as an indicator is unavoidable in assessing long-term OHS performance, the sole use of this kind of data leads to significant oversights.

This can be demonstrated by comparing indicators that measure the frequency and severity of accidents with the number of deaths for the same period (using the example given in the previous section). This shows no causal link between the three indicators (Figure 2). Moreover, in the years 2004 - 2006 the number of deaths increased significantly, from four to fifteen while the frequency and severity of accidents declined steadily in the same period.

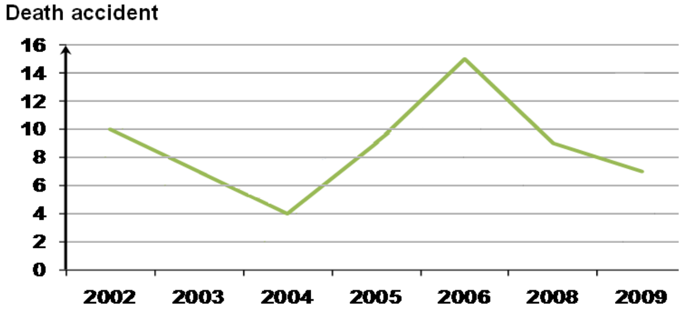

Figure 2: Evolution in the number of deaths

Unlike many other management areas which are based on the analysis of success factors, the traditional measure of safety performance is based on system failures that are the cause of accidents and illness. The absence or lack of safety measured in this way and used numerically does nothing to help to anticipate future events that have so far never arisen (Cambon 2007). Moreover, the very random nature of accidents makes it difficult to draw any conclusions.

A second limitation is related to the construction of the indicator itself. Accident rates are not consistently reported, and there are disparities between the scales employed (Textoris, 2010). The reporting of events may vary, even within the same industrial group. This disparity in the construction of metrics makes it difficult to find common ground for measurement and comparison.

Another gap identified is the low cognitive capacity of these indicators. Generally expressed as an index or ratio, they provide very little information about the situation. A frequency index of 5 is, for example, much better than 10, but this piece of data is very abstruse for most employees and will not help in decision-making. OHS actors cannot therefore not improve or correct themselves using methods that are well-known to risk prevention specialists, and that form the drivers for OHS activities.

Moreover, a sudden increase in the index of frequency or severity of adverse events risks the mobilization of extraordinary resources in order to prevent the problem recurring. A lack of vision in the evolution of OHS strategy may cause poor resource management. This ad-hoc management method risks having a detrimental effect on new, much less well-understood situations, which may a have a dramatic impact on overall system performance.

Finally, OHS actors are guided by the traditional paradigm which is based on the measurement of performance by results. The rewards for achieving goals may bias the situation on the ground if the number of adverse events is under-reported to facilitate the achievement of objectives. System performance is thus artificially improved.

It is therefore necessary to place these result indicators in the context of the overall management system and not use them solely for performance measurement. It then becomes appropriate to design a system of advanced indicators for OHS sub-processes in order to improve the measurement and level of overall system performance.

2.3 Towards lagging and leading OHS indicators

The literature deals extensively with the differences between leading and lagging indicators. Typically, it demonstrates the lack of consensus on a naming convention. We propose in this article to adopt a simple definition that incorporates the principal features of the most widely used designations. An indicator is described as leading or lagging according to its place in the management system and its operational goal (Figure 3). Lagging indicators indicate results, and leading indicators either act as control (implementation) or intermediate indicators. It should be noted that depending on the angle of analysis, and its place in the management system, an intermediate indicator may be used to evaluate the results of activities that underlie the overall management system.

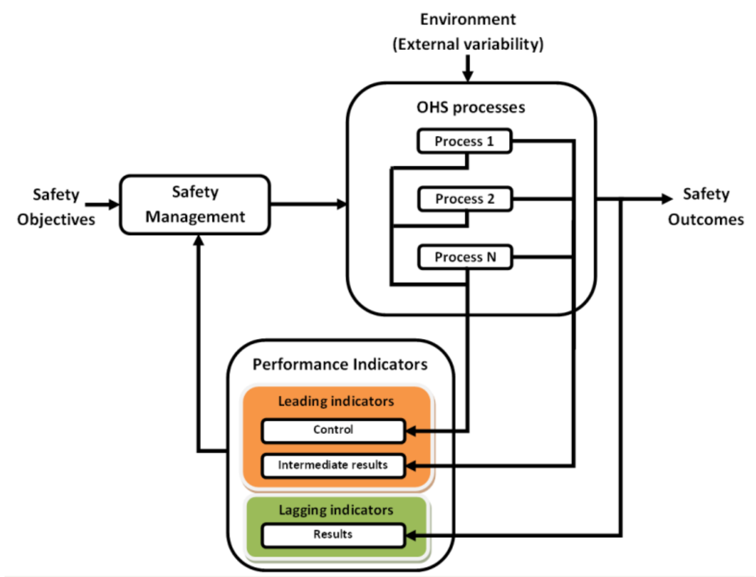

Figure 3: Leading and lagging indicators in an OHS management system

3. Benefits of Balanced Scorecards

3.1 Scorecard overview

The scorecard tool is designed to facilitate decision support. It provides an overview of the processes implemented for achievement of strategic objectives. The quality of a scorecard comes primarily from its ability to inform the various actors in the management system of the presence of deviant situations, and to facilitate decision-making in order to implement the necessary corrective actions.
The representation of the scorecard must meet the needs of users, and reflect the nature and evolution of information. Scorecard indicators are classified by category and level of importance. The information provided should be periodically updated (at intervals appropriate to the particular management system in question); interpretation of the measurements provided by these indicators must make it possible to rapidly address any dysfunctions noted. Depending on the nature of the information required, indicators are represented digitally, graphically, with or without comment, and with or without historical data showing evolution over time. Finally, the quality of a scorecard rests upon both its ability to alert managers to the occurrence of deviant or unwanted event (in order to reduce, or ideally, remove it), and on its ability to anticipate the consequences of adverse situations.

3.2 Brief review of OHS Scorecards

There are already several examples of scorecards used for OHS management. Greenstreet Berman (2006) proposes a tool for measuring health and safety performance. Their study compares the level of OHS performance along two dimensions: implementation (health and safety management, occupational health programs) and results (injury rates, employee sickness absences, major incidents). Each of these components is rated, and a weighting system is used to calculate an overall level (rate) of OHS performance (Figure 4). OHS performance along these dimensions is compared to the performance of other companies from the same sector of activity (mean, highest and lowest values).

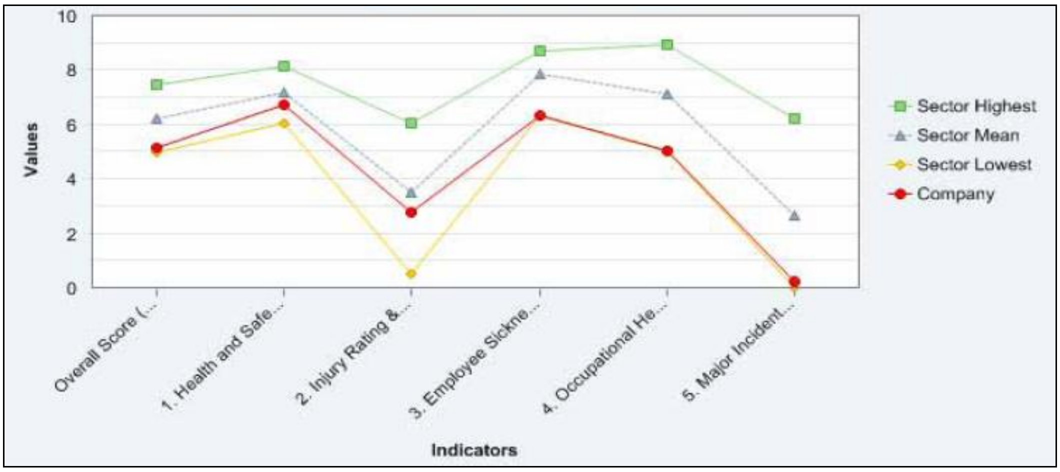

Figure 4: OHS Scorecard using a weighting system to calculate an overall level of performance (Greenstreet, 2006).

Mayer et al. (2007) distinguishes three types of indicators to measure OHS performance: resource, risk and results. They discuss an OHS scorecard model used by a large industrial plant. This scorecard combines several OHS indicators into five categories: accident statistics (number, frequency etc.), vehicle accidents (frequency, number of injuries, average cost etc.), minutes of safety meetings (number of issues treated, participation rates etc.), personal protective equipment (availability and condition etc.), and safety audits (number of audits carried out etc.). Each of these categories corresponds to a scorecard page that groups the various indicators.

3.3 Assets of Balanced Scorecard for OHS management

The Balanced Scorecard concept (Kaplan & Norton, 1996) was originally intended to be used by companies in their strategic management and implementation activities. It is interesting to now see how the application of this tool can be transferred from the domain of management systems to that of health and safety.
The value of the approach lies in the ability to take into account factors other than just the end result. The Balanced Scorecard tool attempts to define various strategic areas and dimensions where initiatives or actions can contribute to the achievement of goals (or one overall goal). These measures result from an overall strategy deployed across the whole organization. While the primary purpose of a business may be profitability and financial gain, the control and measurement of performance is not based solely on financial considerations. As part of their framework, Kaplan and Norton recommend using several strategic areas to evaluate performance (financial, customer relations,

internal business processes, learning and growth). The Balanced Scorecard tool has the ability to integrate these performance indicators with advanced indicators that correspond to various domains and levels of detail in the system. The aim is to fill some of the gaps identified above. In this context, construction of an OHS Balanced Scorecard is relevant to the proactive management of health and safety.

4. Construction of an OHS Balanced Scorecard for the aeronautics industry

This section discusses the construction of an OHS Balanced Scorecard for a French aerospace company. First, the experimental context is outlined. Then, the benefits of the regulatory compliance and occupational risk management processes in reducing exposure to risk are discussed. This description is supported by class models which help to demonstrate the operation of these processes and to build models of leading indicators. Finally, the experimental protocol is presented and an OHS Balanced Scorecard which integrates leading indicators for occupational risk management and control of regulatory compliance is presented and discussed.

4.1 Context of the experimentation

The company concerned is a global player in the field of aeronautics. The activities of this company are very varied and they have multiple production sites. Testing was carried out in buildings at one of these sites. The selected site specializes in the construction of new aircraft. Activities are diverse: assembly operations, surface treatment, storage of chemicals, etc. The risks associated with these production activities are many and varied: chemical hazards, handling, mechanical, fire and explosion, electrical, work environment, etc.

4.2 The benefits of regulatory compliance and risk management

Good safety results depend on the normal functioning of each of the interacting processes in the management system. Amongst these processes, the management of regulatory compliance and the management of occupational risk are particularly interesting activities.

These two processes make it easier to examine the corresponding sub-processes of a Safety Management System (SMS). They help to identify and implement various barriers to protect against and prevent hazards (Figure 5). They help to reduce risk through prevention measures used to isolate the threat, and protective barriers which limit the adverse consequences of an event.

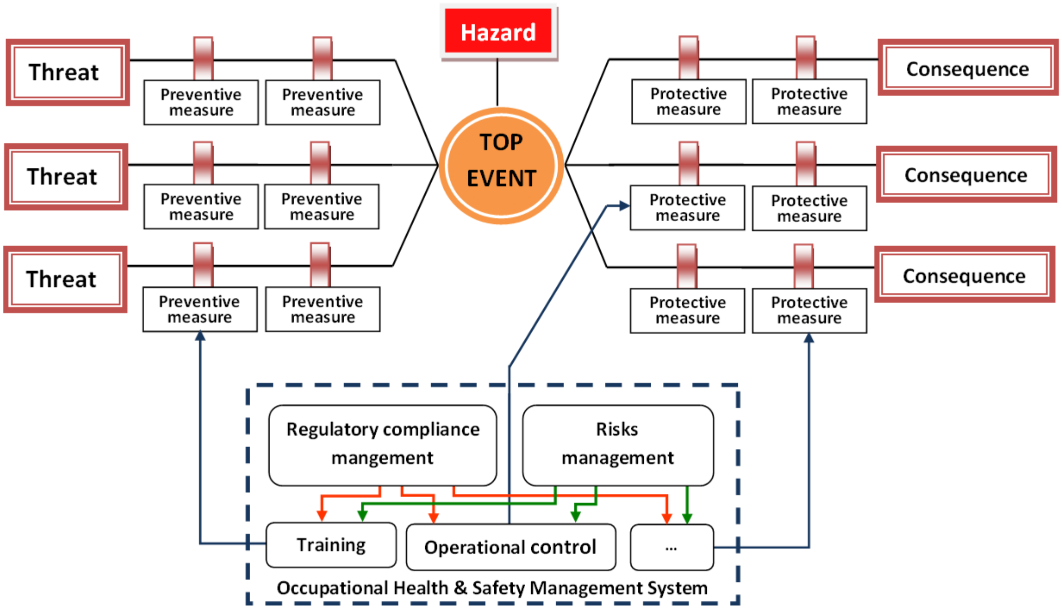

Figure 5: The bow-tie diagram showing how sub-processes in safety management systems help to control hazards.

Regulation can be used as a knowledge base, enabling companies to implement various protection and prevention measures. Once the applicable regulatory limits have been determined, compliance assessments help to identify legal obligations.
Risk analysis is used to round out the list of measures to be implemented. It provides a more exact and responsive analysis of actual work situations. This analysis is necessary because regulations are not exhaustive in terms of protection and prevention measures. Risk analysis results in the identification and implementation of preventive measures and safeguards aimed at reducing the criticality of risk.
The construction of advanced indicators for these two processes contributes both to improved measurement of performance in safety management systems, and proactive OHS management. Regulatory requirements and preventive or protective actions can easily be classified using standard OHS management principles (communication, training, etc.). This classification provides an alternative to the view of regulatory compliance management as a strictly legal affair, and identifies weaknesses in management which the company needs to focus on.

4.3 Models of regulatory management and leading indicators

The objective of the regulatory compliance management process is to comply with all applicable regulatory requirements. The class diagram shown below (Figure 6) describes the various elements involved in static modeling of the regulatory compliance management process. This UML (Unified Modeling Language) diagram provides a visualization of the data structure for each class and the interrelations between them (generalization, dependency, aggregation, composition, etc.). Dynamic and temporal aspects of the system are not shown.

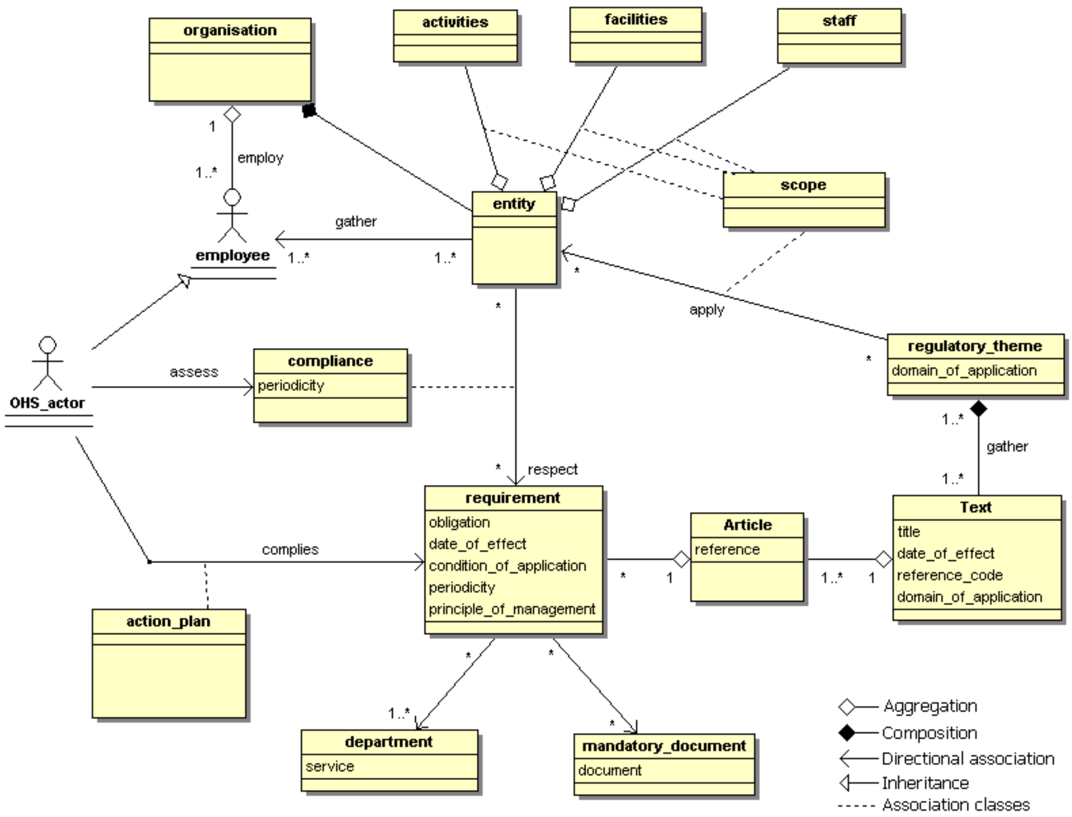

Figure 6: Model of class diagram related to regulatory compliance management

This demonstrates that the regulatory scope of an entity belonging to an organization is related to the types of activities, infrastructure (facilities) and categories of personnel working for the entity. Compliance or otherwise in this scope can be evaluated from an examination of the applicable regulations, which are themselves decomposed and translated into regulatory requirements. Each of these requirements can be associated with one or more departments in the organization (such as maintenance, procurement, management, etc.) and compliance (or failure to comply) is recorded in a binding document. The OHS specialist evaluates the level of compliance of the entity by verifying that each of the applicable regulatory requirements is met. Compliance activities are facilitated through an action plan which determines a provisional completion date and the person in charge.

In this SMS sub-system, it is therefore useful to construct and use leading indicators on: the rate of compliance of the organization, the extent to which it has been assessed and actions scheduled (Figure 7).

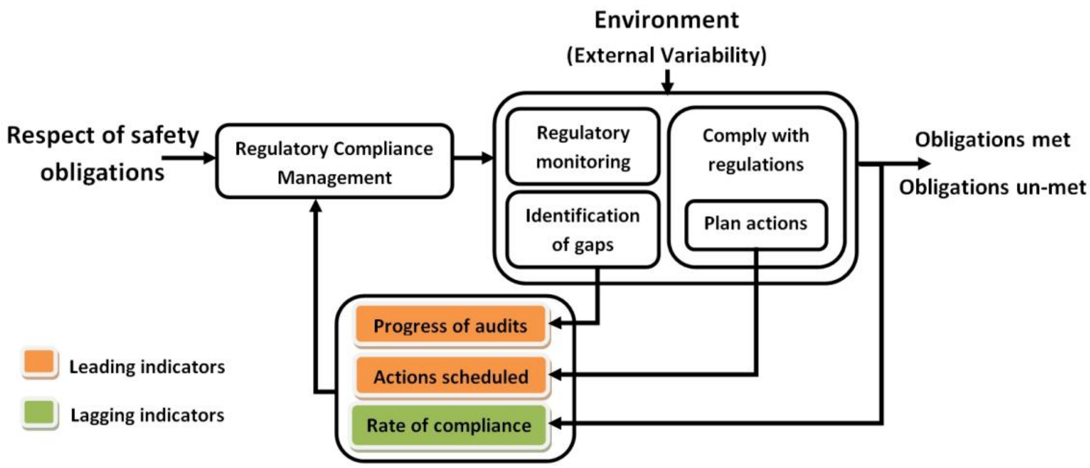

Figure 7: Regulatory Compliance Management model

Whether obligations are met or not enables the level of compliance to be determined. This indicator is the result of the various actions carried out (definition of the applicable scope, identification of discrepancies, planning and achieving compliance). Various control and implementation indicators can be created from these sub-processes.

The number of requirements assessed relative to the number of applicable requirements allows the construction of a control indicator (progress of completed audits) for the process of identifying discrepancies. This indicator makes it easier to identify the work that remains to be done in identifying discrepancies with regulations. It also in puts into perspective and clarifies the overall level of compliance of an organization, which cannot be assessed without taking into account the appropriate regulatory scope. A second control indicator (identification of a provisional completion date, the person responsible, etc.) can be constructed for the process of planning compliance with un-met obligations. In this case, the planning indicator relates to the number of actions planned compared to the number of necessary measures. Regulatory monitoring involves review of the applicable regulatory domain and the identification and evaluation of new regulatory requirements. As regulations are constantly changing, it should be done on a regular basis.

4.4 Models of occupational risks management and leading indicators

Risk assessment is a regulatory requirement. It aims to identify the risks to which employees are exposed and to reduce the consequences of these risks. Using the same abstraction and modeling principles applied to the regulatory compliance management process, the management of occupational risk sub-process can be modeled (Figure 8).

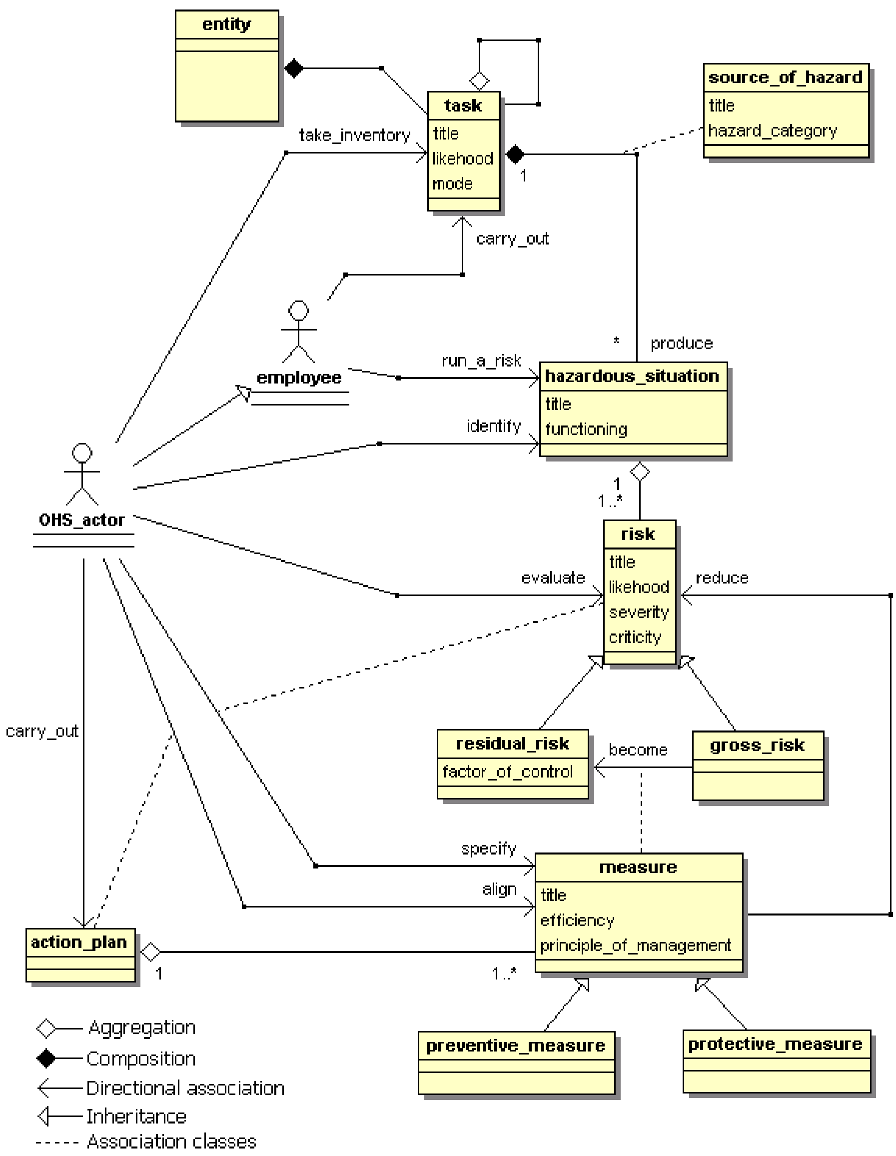

Figure 8: Model of class diagram related to occupational risks management

The various tasks that employees perform expose them to dangerous situations. The OHS specialist is responsible for the preparation of an inventory of these hazardous tasks and identifying any related dangerous situations. Each of these situations can be classified according to the initial hazard source (fire, handling, biological, etc.). From these various situations, the OHS specialist undertakes an assessment of the various risks related to dangerous situations. This involves determining a level of criticality of risk from its probability of occurrence and its severity level. Two types of risk can be distinguished: gross risk, which is the risk before the implementation of measures; and residual risks which are risks where the level of criticality has been reduced by the implementation of measures. Measurements can be of protection (which reduces the severity of a risk) or prevention (which reduces the probability of occurrence of the event). Again, the implementation of measures is facilitated by an action plan.

In the management of occupational risk sub-process, it is useful to construct and use a model of leading indicators on: the level of organizational risk control, the extent to which measures identified to reduce risks have been implemented, and the degree of implementation of the action plan (measures scheduled) (Figure 9).

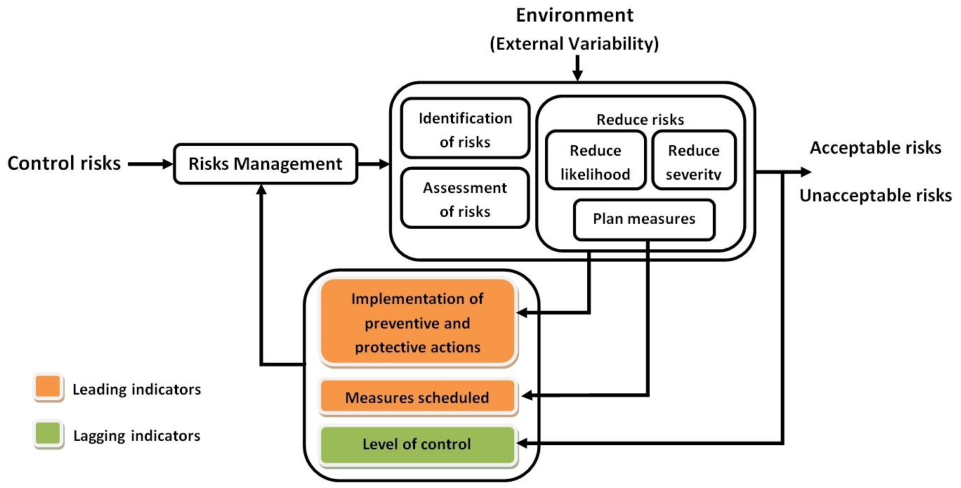

Figure 9: Occupational risks management model

A threshold of criticality is determined by OHS professionals, from which measures must be implemented in order to eliminate, or at least reduce the risk to a criticality level deemed acceptable. The most significant levels of criticality are given priority. Using this threshold principle, an indicator can be created for the control of occupational risk. It highlights the proportion of risks estimated as being under control (or acceptable) compared to all risks identified. This indicator is the result of various measures put in place to control occupational risk. A control indicator can be created from the identification and implementation of the various protective and preventive measures intended to reduce the criticality of risk. A second control indicator (identification of a completion date, a project leader, resources, etc.) can be created for planning of the implementation of these measures, which facilitates their deployment

4.5 Analysis and assessment protocol

The study was implemented in the second half of 2009. It aimed to measure the extent of regulatory compliance and risk control for one production sector using PREVENTEO® software (see www.preventeo.com).

Compliance assessments concerned various regulatory areas relevant to the company in question. Audits (based on a set of questions and answers) were conducted. This enabled applicable regulatory requirements (whether met or not) to be identified, for the various work units distributed across the study area. Regulatory compliance management indicators are created from the audits carried out. As regulatory requirements are linked to prevention measures (training, document management, etc.) it is also possible to construct regulatory compliance indicators using these

measures. Audits identified both applicable and non-applicable regulatory requirements. For applicable requirements, various states are possible: 'Compliant' when the regulatory requirement is met, 'Non-compliant', when the obligation is not met, and 'Evidence to be provided' when the status of the requirement could not be identified.
Risk assessments identified sources of potential hazards related to workstation activities, then estimated the probability of occurrence and severity for each risk identified. The product of these two factors determines the level of criticality of the risk. This analysis determines the extent of risk control at each workstation. The most critical risks are given priority in the identification of protection or prevention measures. In order to clarify the results, various levels of criticality were determined. Among the risks considered 'acceptable' (or 'controlled'), we find two levels of criticality classification: weak and insignificant. 'Unacceptable' ('uncontrolled') risks are divided into three classes: moderate, substantial and intolerable. This risk classification enables better identification of priorities. Risk control indicators are constructed by aggregating the set of risks analyzed. Each risk is analyzed, and the frequency and severity estimated. The product of these factors enables a level of criticality to be established. The analysis of various tasks enables dangerous situations to which employees are exposed to be identified. These situations are grouped into different hazard categories. Finally, protection and prevention measures both implemented and planned are associated with a prevention measure.

4.6 Illustration of leading indicators

The regulatory audits carried during the testing period identified regulatory requirements that are met and those that are not, and enabled the creation of performance indicators for the management of regulatory compliance.

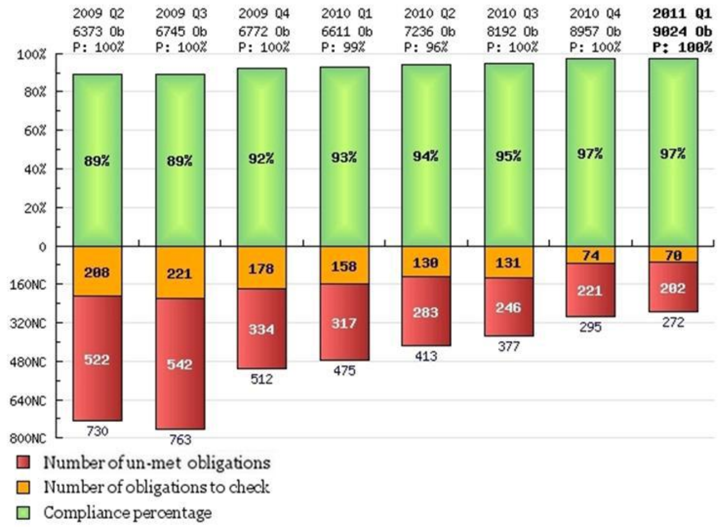

Figure 10: Evolution in compliance with regulatory obligations from 2009 to 2011

This indicator shows that the number of applicable regulatory obligations increased significantly from 2009-2011 (Figure 10). The increase is from 6,373 requirements assessed as applicable in the first quarter of 2009 to over 9,000 in 2011. Despite this increase in the applicable scope, the organization has improved its level of control of regulatory compliance, from 89% to 97%. The number of un-met obligations has declined, from 730 to 272.

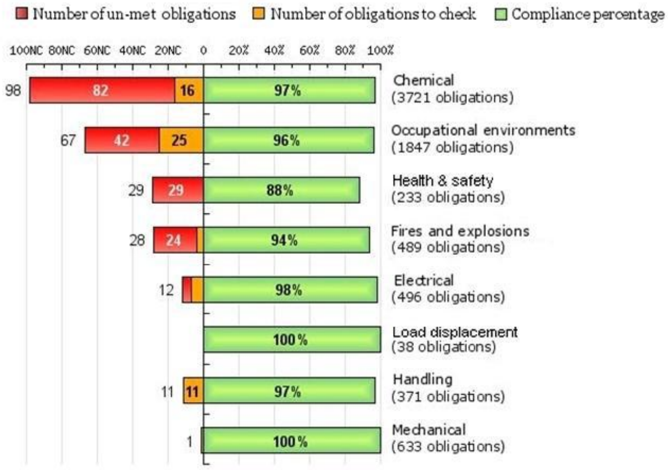

Figure 11: Compliance with regulatory obligations: categorization of hazards

Compliance assessments were carried out in various regulatory areas. Each of these areas has been categorized (Figure 11). The classification of regulations into categories provides a new perspective on the distribution of regulatory requirements. Legal requirements related to chemicals have a significant impact in our study. More than 3,700 regulatory requirements apply to the organization. Conversely, regulatory requirements related to load handling activities only apply to very few activities (38 obligations).

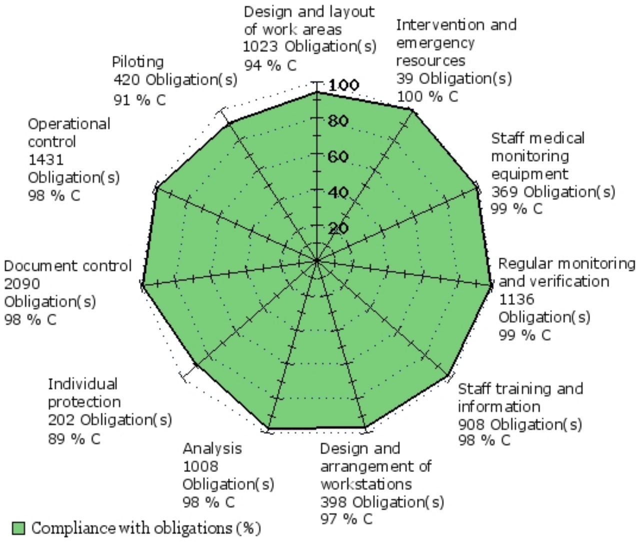

Figure 12: Level of regulatory compliance according to prevention measure

The evaluated regulatory requirements were all associated with prevention measures, which correspond to management principles (individual protection, staff training, operational control, etc.). Consolidating the audit results using these various classifications highlights areas where the organization must improve (Figure 12). In this case study, regulatory requirements for personal protective equipment are not all met (89%). This leads to the conclusion that the provision of personal protective equipment would significantly reduce risks and improve the overall performance of the safety management system.

Risk analysis identified 841 risks at various levels (Figure 13). Among the 841 risks, 387 were considered as ‘controlled’ (an acceptable criticality level) and 446 as ‘uncontrolled’. Among these 446 risks, 325 were estimated as ‘moderate’, 106 as ‘substantial’ and 15 as ‘intolerable’. This classification according to various levels enables the company to treat the highest risks as a priority.

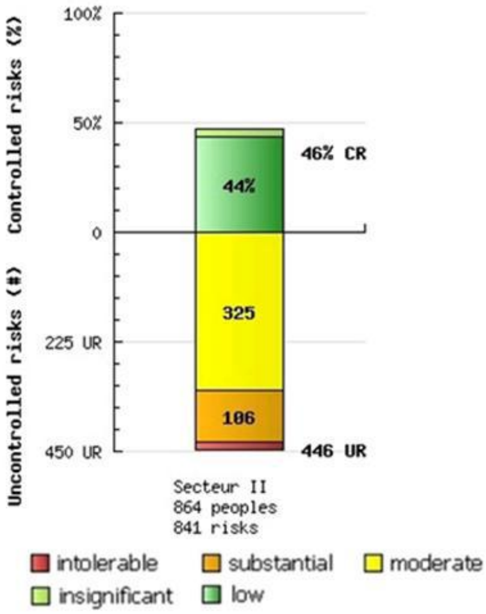

Figure 13: Occupational risks control indicator

Analyses were performed by linking the various dangerous situations identified with hazard families. This allows the creation of risk control indicators organized by family (Figure 14). This classification reveals that the organization is mainly exposed to risks related to the work environment (100 uncontrolled risks) and very little risk associated with working conditions.

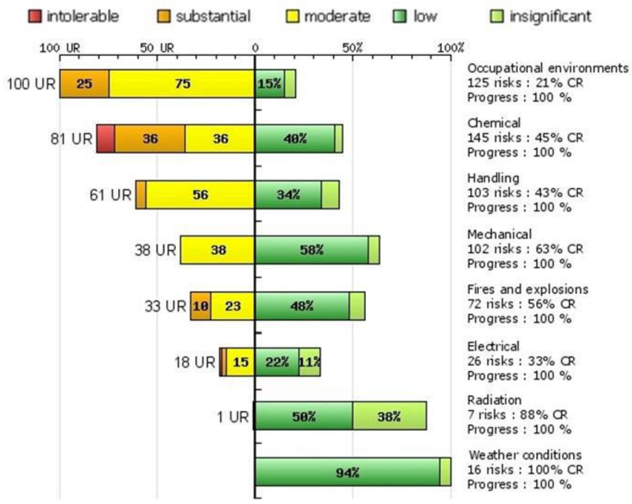

Figure 14: Occupational risks control in relation to hazard categories

5. Summary & Conclusion

This experiment in an industrial establishment related to the aerospace sector has shown that the use of advanced indicators, in the form of a Balanced Scorecard offer interesting opportunities for measuring performance and monitoring of OHS management systems. Traditional OHS indicators, although needed to validate a long-term OHS strategy and to promote organizational learning, are insufficient to meet the demands of a proactive safety management system. The construction of advanced indicators for two OHS management sub-processes (control of regulatory compliance and occupational risk) makes it easier to identify actions to be implemented.

This research has enabled improvement in the performance measurement of OHS management systems and better control performance variability. To further enhance this control, it would be interesting to identify and construct other advanced indicators in different OHS management processes (operational command, control, analysis, etc.) as well as processes related to the strengthening of safety culture, through improved measurement techniques.

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